A Centering Analysis of Word Order in Japanes

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1. Introduction

In flexible word order languages, word order can be changed without influencing grammatical relations between constituents in a sentence. In Japanese, a relatively flexible word order language, major constituents, except for verbs, are generally allowed to be freely ordered because case particles provide information for grammatical relations between arguments and the predicate. Therefore, an NP bearing any grammatical function (subject, direct object, indirect object) can occur in all possible positions. For example, not only SOV sentences but also OSV sentences are grammatical in Japanese transitive clauses. Example (1a) shows an SOV sentence, and example (1b) illustrates an OSV sentence. What is important here is that both the SOV sentence and the OSV sentence convey the proposition *Taro ate an apple*. Japanese speakers, however, must choose one of the word orders in order to communicate the information. This is a general feature of all flexible word order languages. What factor, then, determines the choice of word order in flexible word order languages? I will explore this issue from the view point of Centering Theory.

(1)	a.	Taro-ga	ringo-o	tabe-ta.	SOV
		Taro-NOM	apple-ACC	eat-PAST	
		'Taro ate an apple.'			
	b.	Ringo-o$_1$	Taro-ga	tabe-ta.	OSV
		apple-ACC	Taro-NOM	eat-PAST	
		'same meaning as (1a)'			

This paper is organized in the following way. Section 2 reviews previous studies. Section 3 presents a Centering Theory analysis of Japanese based on corpus data and discusses the results, focusing on insights that Centering Theory can give us with regard to word order. Section 4 is devoted to the conclusion.

2. Previous Studies
2.1. Word Order
2.1.1. Syntactic Background

In flexible word order languages, various word order permutations share the basic meaning of a sentence. However, it has been revealed that some word orders are simpler than others, and that syntactically complex word orders require further computation that is not required by syntactically simple structures. Theoretically, it has been proposed that scrambled word orders are transformed from canonical word order leaving a trace in the scrambled constituent's canonical position (Hoji 1985; Mahajan 1990; Saito 1985). SOV, for example, is a canonical word order sentence, which is syntactically the most basic word order in Japanese. OSV, on the other hand, has scrambled word order, which is derived from the canonical word order by moving the object to the front of the clause.[1]

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[1] We leave the identity of the moved object open here, as the landing site of the scrambled object is

Empirically, it has been reported that scrambled word orders in numerous languages incur a larger processing cost as compared to canonical word order. Rösler, Pechmann, Streb, Röder and Hennighausen (1998) and Weyerts, Penke, Münte, Heinze, and Clahsen (2002) provide examples from German, Frazier and Flores d' Arcais (1989) from Dutch, and Sekerina (2003) from Russian. In particular, several studies on Japanese have observed scrambling effects in self-paced reading tasks (Chujo 1983; Koizumi and Tamaoka 2010; Miyamoto and Takahashi 2002; Tamaoka, Sakai, Kawahara, Miyaoka, Lim, and Koizumi 2005), eye-movement experiments (Mazuka, Ito, and Kondo 2002), cross-modal lexical priming experiments (Nakano, Felser, and Clahsen 2002), fMRI experiments (Kim, Koizumi, Ikuta, Fukumitsu, Kimura, Iwata, Watanabe, Yokoyama, Sato, Horie, and Kawashima 2009), and ERP experiments (Hagiwara, Soshi, Ishihara, and Imanaka 2007; Ueno and Kluender 2003).

Summing up, previous studies consistently revealed scrambled word orders to be more complex than canonical word order sentences, and thus they incur higher processing costs associated with their syntactical complexity. The crucial point here is that there exist scrambled word orders in spite of the increased processing costs. What, then, is the purpose of changing the word order in flexible word order languages? In the next section, I will give an overview of previous studies associated with this issue.

2.1.2. Information Based Approach

There have been numerous studies which suggest that word orders are primarily driven by discourse factors in flexible word order languages. Kuno (1987) observed that the preferable word order in Japanese is given-new ordering, which means that given information is mentioned early and new information later[2]. In particular, Ferreira and Yoshita (2003) revealed that, in Japanese, given-new word orders are easier to remember and recall than other word orders. In Finnish, a relatively flexible word order language, Kaiser and Trueswell (2004) reported that OVS ordering is appropriate when O is given information but S is new information. Some studies have attempted to account for word orders by recourse to topic and focus (see Aoyagi 2007 and Kaiser 2006 for focus)[3]. Ishii (2001) proposed that, in Japanese, sentence-initial scrambled constituents might be shifted topic, which introduces a new topic or a new point of view. For instance, (2a) is unacceptable but can be made acceptable by adding *sono* as in (2b), which marks the definiteness and givenness of an NP. This supports the claim that scrambled constituents are a kind of topic because topic generally correlates with definiteness and givenness.

(2)	a.	*Okane-o	dare-ga	nusunda-no?
		money-ACC	who-NOM	steal-PAST-Q
		'Who stole money?'		
	b.	Sono-okane-o	dare-ga	nusunda-no
		that-money-ACC	who-NOM	steal-PAST-Q

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controversial. Among the possibilities raised for the landing site of scrambling are the TP-adjoined position, (Saito 1985)TP Spec (Miyagawa 2010), and higher projections than TP Spec (Saito 2009).
[2] The term given information means what is known to both speakers/writers and hearers/readers, and the term new information represents what is known to speakers/writers but not known to hearers/readers.
[3] The definitions of topic and focus have remained highly controversial, but I regard topic as what the sentence is about, and, as for focus, I do not define it. This is because the main purpose of this paper is to analyze word order by Centering Theory, which is considerably concerned with topic but not with focus.

'Who stole that money?'

   c.   Sono-okane-wa   dare-ga   nusunda-no

          that-money-TOP   who-NOM   steal-PAST-Q

          'As for that money, who stole it?'

In addition, scrambled constituents do not have contrastive meaning whereas *wa*-marked constituents can[4]. For example, the scrambled constituent *Sono-okane-o* in (2b) does not have the meaning 'As for that money, but not for the other money', whereas the *wa*-marked constituent *Sono-okane-wa* in (2c) may have it. This infers that the scrambled constituents differ from the *wa*-marked constituents in topicality.

     In sum, it has been demonstrated that discourse factors have an influence on the choice of word order in flexible word order languages. One important point to note here is that word orders have a connection with topicality. I will explore the topicality varying from one word order to another using Centering Theory.

2.2. Centering Theory

     Centering Theory (CT) is a model of local discourse coherence which was first formulated by computational linguists for tracking the participants' center of attention in discourse (Brennan, Friedman and Pollard 1987; Grosz, Joshi, and Weinstein, 1983, 1995; Joshi and Weinstein, 1981; Kameyama 1985). As a theory of coherence, it accounts for the interactions between local coherence and preferential choices of how to express a proposition.

(3)   a.   John went to his favorite music store to buy a piano.

         b.   He had frequented the store for many years.

         c.   He was excited that he could finally buy a piano.

         d.   He arrived just as the store was closing for the day.

(4)   a.   John went to his favorite music store to buy a piano.

         b.   It was a store John had frequented for many years.

         c.   He was excited that he could finally buy a piano.

         d.   It was closing just as John arrived.

According to Grosz, Joshi and Weinstein (1995), for instance, although discourse (3) and (4) describe the same event, it is probably uncontroversial to say that (4) is not as felicitous as (3). A reason behind this is that (3) is more coherent than (4) because (3) centers around a single individual, *John*, while (4) describes the situation from inconsistent points of view, *John* and *music store*. In other words, (3) is preferred because it has the same center through (3a), (3b), (3c), and (3d). In the next section, I will discuss the detailed mechanisms of CT.

2.2.1. The Basic Centering Algorithm

     The basic assumption of CT is that speakers will make a link between a referent in their current utterance and a referent in their previous utterance so that they can maintain local coherence in their utterance. This referent is called backward-looking center (Cb) which is a link with the previous sentence; it is the most significant discourse referent under discussion in both current and previous utterances. To put it more informally, Cb is what the sentence is about. The point that I should note

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[4] The particle *wa* is generally regarded as a topic marker in Japanese, but it is often used to express contrast (Kuroda 1979, 2005).

here is that Cb must occur not only in the current utterance but also in a previous utterance. This term usually corresponds to Topic in that both terms mean what the sentence is about, but there is no more than one $Cb(U_n)$ in the utterance, which means that multiple Cbs are not allowed in the Centering Theory Algorism. On this point, Cb is different from Topic based on syntactical analyses of the left periphery (Rizzi 1997), and it is similar to main topic in the multiple topic analysis offered by Erteschik-Shir (2007).

CT simultaneously presupposes that speakers draw on referents from their current utterance to frame their next one. These referents are called forward-looking centers (Cfs), which are defined as a set of ordered referents corresponding to referents mentioned in the current utterance. They are a list of all discourse entities in a sentence that may be linked to a succeeding utterance. In other words, Cfs are candidates for becoming Topic in the following utterance. The list of Cfs is ranked based on salience, defined most often in terms of grammatical relations: SUBJECT is higher than OBJECT which is higher than OTHER constituents. Informally speaking, the ranking of Cfs corresponds to the likelihood for them to become the Topic in the following utterance. It has, however, been said that Cf ranking is not so much universal as language-specific, depending on the means which a language provides for indicating discourse functions (Walkerm Iida, and Cote 1994). Based on Walker et. al. (1994), I will add Topic to the Cf rankings[5] for analyzing Japanese sentences: TOPIC [SUBJ or OBJ] > SUBJECT > INDIRECT OBJECT > DIRECT OBJECT>OTHER constituents.

The highest-ranked member of the Cfs is designated as preferred center (Cp) and it is the most probable candidate of a Cb in a succeeding utterance. One of the members of the Cfs is a Cb that is the highest-ranked entity from the previous utterance that is realized in the current utterance. Besides the Cf ranking, zero pronouns and pronouns have an effect on the choice of Cb. If some referent of the preceding utterance is realized as a zero pronoun in the current utterance, it must be the Cb. This condition can also be applied to pronouns. On the other hand, if there are both a zero pronoun and a pronoun in the current utterance and their referents are in the preceding utterance, the zero pronoun precedes the pronoun as a candidate for the Cb of the current utterance. Those rules are called Pronoun Rules which will be stated formally below. Behind the rules, there is an idea that pronouns are more coherent than other referents because they require an antecedent in the preceding context. In addition, these rules state that zero pronouns and pronouns are higher than Cfs as Cb candidates.

Example (5) illustrates how Cb, Cf, and Cp interact. There is no Cb in (5a) because a preceding context does not exist, although Cb must exist in both current sentences and preceding sentences. This indicates that (5a) is the opening of a new discourse segment. In (5b), on the other hand, *Taro* is Cb because he occurs in both (5a) and (5b) despite him not being the Cp in (5a). Cp in the current sentence tends to be Cb in the preceding sentence, but a Cf other than Cp in the preceding sentence can be Cb in the current sentence if Cp in the preceding sentence is not realized in the current sentence. Moreover, instead of (5b), if both *Hanako* and *Taro* are referred to as in (6b) but only *Taro* is realized as the pronoun *Kare* "he", *Taro* will be Cb in (6b) although Cfs based on grammatical relations predict that *Hanako* is preferable to *Taro* for Cb. This is because the pronoun rule has a priority to grammatical relations for determining Cb, and hence *Kare* "he" is the most plausible candidate in this case.

(5)   a.   Hanako-ga   Taro-o   pātī-ni   saso-tta
               Hanako-NOM   Taro-ACC   party-DAT   invite-PAST
               'Hanako invited Taro to the party. '

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[5], Below, I will use the term grammatical relations to refer to traditional grammatical relations plus TOPIC in relation to Cf ranking for ease of reference

| Cb: | [?] | Cf: | [Hanako, party, Taro] |

Cb: [?]   Cf: [Hanako, party, Taro]
Sono-toki   kare-wa   kintyo-shite-ita
that-time   he-TOP   nervous-be-PAST
'Speaking of him, he was nervous at that time. '
Cb: [Taro]   Cf: [Taro]

(6)   a.   Hanako-ga   Taro-o   pātī-ni   saso-tta
                Hanako-NOM   Taro-ACC   party-DAT   invite-PAST
                'Hanako invited Taro to the party.'
                Cb: [?]   Cf: [Hanako, party, Taro]
        b.   Kare-wa   Hanako- ni   ai-o   katat-ta.
                he-TOP   Hanako-DAT   love-ACC   speak-PAST
                Cb   [Taro]   Cf   [Taro, Hanako, love]
                'He confessed his love to Hanako.'

The centering framework described above can be formally summarized in (7), (8), and (9). In (7), Cb is determined by Cfs which are ranked by salience, in particular by grammatical relations. Largely based on grammatical relations, the Cf ranking I will employ is demonstrated in (8). (9) means that a pronoun is the highest-ranked candidate for Cb irrespective of Cf ranking.

(7)   a.   Each utterance U_n has at most one backward-looking center, $Cb(U_n)$, and, if U_n has $Cb(U_n)$, the referent of $Cb(U_n)$ must be realized in both U_{n-1} and U_n.
        b.   Every referent of the forward-looking centers list, $Cfs(U_n)$, must be realized in U_n. The highest-ranked member of $Cfs(U_n)$ is the preferred center, $Cp(U_n)$. $Cp(U_n)$ is the most probable candidate of $Cb(U_{n+1})$.
        c. $Cb(U_n)$ is determined by $Cf(U_{n-1})$, and, to put it more concretely $Cb(U_n)$ is the highest-ranked referent of $Cf(U_{n-1})$ that is realized in U_n.

(8)   Ranking of the Cfs for Japanese
        Topic [SUBJ or OBJ]> Subject > Direct Object > Indirect Object>Other

(9)   Pronoun Rules
        If some referent of U_n is also realized as a zero pronoun in U_{n+1}, this referent is $Cb(U_{n+1})$. Similarly, if there is a pronoun in $Cb(U_{n+1})$ which is already mentioned in $Cb(U_n)$, that pronoun is the $Cb(U_{n+1})$. If there are both a zero pronoun and a pronoun, however, the zero pronoun is preferable as $Cb(U_{n+1})$.

2.2.2. Transitions

On the basis of the options available to speakers/writers for maintaining continuity, the Centering model clarifies a set of transitions that measure the coherence of the discourse segment in which the utterance occurs: Continue, Retain, Shift, and Zero. These indicate the local discourse relations between a current utterance and the previous utterance, and they are called center transitions (Ct). The four types of Cts are divided depending upon whether the two utterances share the same Cb or not, and whether the Cb of the second utterance is also Cp. Firstly, Continues arise when the Cb of the current utterance corresponds to the Cb in the previous utterance ($Cb(U_{n-1})=Cb(U_n)$) or if the previous utterance has no Cb but the current utterance has a Cb ($Cb(U_{n-1})=$ null and $Cb(U_n)\neq$ null),

and the Cb of the current utterance is the same as the Cp of the current utterance ($Cb(U_n)=Cp(U_n)$). In other words, Continues occur when the speaker continues talking about the same entity that he or she was talking about before. Secondly, Retains occur when the Cb of the current utterance is the same as the Cb of the preceding utterance ($Cb(U_{n-1})=Cb(U_n)$) or if the previous utterance has no Cb and the current utterance has a Cb ($Cb(U_{n-1})=$null and $Cb(U_n)\neq$null), but the Cb of the current utterance is not the same as the Cp of the current utterance ($Cb(U_n)\neq Cp(U_n)$). To put it another way, the speaker selects Retain when he or she has been talking about a referent but intends to signal that they will be making a shift onto a new referent. Thirdly, Shifts are realized when the Cb of the current utterance is not the same as the Cb of the preceding utterance ($Cb(U_{n-1})\neq Cb(U_n)$). This transition typically occurs when a speaker intends to change the topic of an utterance. Lastly, Zero is a kind of transition which occurs when there is no Cb in the current utterance ($Cb(U_n)=$null). This transition is supposed to occur when the speaker begins a new discourse segment, and there are no referents in the preceding utterance.

The three major transition states (Continue, Retain, and Shift) are ranked in terms of how strongly each transition maintains discourse coherence; Continue is more coherent than Retain which is more consistent than Shift. That is, talking about the same referent is more coherent than shifting the referents (Continue and Retain are preferable to Shift), and maintaining the referent in the highest-ranked position is more coherent than realizing it in another position (Continue is preferable to Retain). Behind this rule, there is an assumption that speakers/writers try to maximize the discourse coherence between the preceding utterance and the current utterance. This intuition is considered to be reflected in frequency of each transition, which means that Continue seems to occur more frequently than Retain which seems to arise with higher frequent than Shift. Note also that Zero is not included here. In sum, transition algorithms have two factors, Cb and Cp, which determine to which transition a discourse segment belongs. This is summarized in (10). Furthermore, the basic three transitions are ordered by discourse coherence, which is shown in (11).This represents the preference for transition ranking. In the next section, I will explore the criteria which are necessary to analyze a complex sentence using CT.

(10)   Centering Transitions

	$Cb(U_{n-1})=Cb(U_n)$ or $Cb(U_{n-1})=$null and $Cb(U_n)\neq$null	$Cb(U_{n-1})\neq Cb(U_n)$
$Cb(U_n)=Cp(U_n)$	CONTINUE	SHIFT
$Cb(U_n)\neq Cp(U_n)$	RETAIN	SHIFT

ZERO: $Cb(U_{n+1})=$null

(11)   Preference for Transitions
        Continue > Retain > Shift
        Zero is independent of the three transitions

2.2.3. Discourse Segment
CT is a theory of local coherence and its basic unit of analysis is a simple sentence with only one predicate. In order to analyze complex clauses which have more than one predicate, it is necessary

to divide them into separates discourse segments. Roughly speaking, a unit of discourse segment coincides with a finite clause except for relative clauses, whether subordinate or not (Kameyama 1998, Hadic and Taboada 2006). Consider an example of a complex clause, which consists of a subordinate clause (12a) and a main clause (12b). Although (12a) is subject to (12b), (12a) is viewed as an independent utterance in CT because it has a predicate with past tense, *ita* 'was'

| (12) | a. | Taro-wa | onaka-ga | suite-i-ta-node, |
| | | Taro-TOP | stomach-NOM | hungry-be-PAST-bacause |

'Because Taro was hungry,'

		Cb	[?]	Cf	[Taro, hungry]
	b.	pro	kinzyo-no	resutoran-ni	it-ta.
		(He)	nearby-GEN	restaurant-DAT	go-PAST

'(He) went to a restaurant nearby.'

| | | Cb | [Taro] | Cf | [Taro, restaurant] |

Note also that there is no overt subject in (12b) because Japanese permits there to be a null subject if its antecedent can be retrieved from the previous discourse. Therefore, it is impossible to segment complex clauses based on whether they have overt subject or not. Rather, it is more reasonable to partition them into multiple utterances based on the number of predicates which they contain. Such approach is adopted in Okumura and Tamura (1996) and I will employ this position except for relative clauses, whose entities are ranked lower than all entities in a main clause with regard to Cf (Miksakai 2002). For example, a subject in a relative clause is ranked lower than an object in a main clause although its grammatical relation is higher than object. The analysis based on whether the clause is finite or not generally corresponds to the one based on the number of predicates, but there exist cases where detailed examination is needed. To put it more concretely, treatment of *te* form 'and' alters the size of a discourse segment. *Te* is a morpheme attached to verbs and sometimes connects verbs, resulting in Verb-Te-Verb (V_1-Te-V_2) form. If one takes a position presupposing a finiteness-based analysis, V_1-Te-V_2 forms will contain only one discourse segment. On the other hand, if one has a predicate-based view, V_1-Te-V_2 forms will be divided into two discourse segments. In Nakatani (2006), for instance, *motte-ki-ta* 'hold-Te-come-PAST' may be one discourse segment or two discourse segments with small pro as the subject of *ki* 'come'. Using a self-paced reading task, he revealed that V_1-Te-V_2 forms a complex verb when V_1 is one of a small number of basic verbs such as *motsu* 'have', and that it should be regarded as a single verb. Thus, I consider V_1-Te-V_2 with V_1 being a basic verb as a single verb, and assume only one discourse segment.

In sum, I segment Japanese complex clauses into each utterance based on the number of predicates they contain, relative clauses and V_1-Te-V_2 forms with basic verbs being exceptions to this position.

2.2.4. Realization

Discourse entities in CT can be realized in two ways. The first is direct realization which ignores potential bridging between the preceding utterance and the current utterance (Grosz, Joshi, and Weinstein 1995). However, limiting realization only to entities that have been explicitly mentioned in the preceding utterance will cause a large number of ZERO transitions. For example, although *Mado* 'window' in (13b) seems to be relevant to *heya* 'room' in (13a), direct realization regards them as completely different entities and the transition of (13b) is ZERO because there are no co-existing entities in (13).

(13) a. Kinō   pro   sono-heya-e   hait-ta.
yesterday   (I)   that-room-LOC   go.into-PAST
'I went into that room yesterday.'

b. Mado-ga   warete-i-ta.
window-NOM   broken-be-PAST
'The window was broken.'

Therefore, indirect realizations of discourse entities that handle bridging relations are also required. They occur when there is an indirect relationship between an entity in the preceding utterance and an entity in the current utterance. According to Poesio (2006), there are various types of indirect realization. They are general noun relation, synonyms and near synonyms relation, superordinate relation, inclusive relation, and part-whole relation. In (13), there is the inclusive relation between *heya* 'room' and *Mado* 'window'. Thus, indirect realization complements data direct realization cannot deal with.

Summing up, direct realization and indirect realization express the relationship between entities which exist directly or indirectly both in the preceding utterance and the current utterance. Having provided an overview of centering algorithm, we are now ready to consider an application of the theory for analyzing word order.

3. A Centering Analysis of Word Order
3.1. Method
3.1.1. Corpus Data

In order to collect Japanese sentences, I employed *Aozora bunko* which is a database of assembled novels written in modern Japanese.

3.1.2. Materials

Four types of sentences were selected from the corpus data, and they were a 2×2 factorial design, with the factors word order (canonical/scrambled, WO), and noun phrase marking (nominative marker *ga* and accusative marker *o*/topic marker *wa*, NPM). Hence, there were four conditions, as shown in (14a)–(14d). They were all transitive sentences. (14a) is an example of a canonical sentence ($S_{NOM}OV$) without a topic marker. (14b) is an example of a scrambled sentence ($O_{ACC}SV$) without a topic marker. (14c) is a canonical sentence with a topic marker ($S_{TOPIC} OV$). (14d) is a scrambled sentence with a topic marker ($O_{TOPIC} SV$). It should be noted that the topic marker is assigned to a sentence-initial constituent. In Japanese, a topic marker in a middle position is exclusively interpreted as contrastive, and thus only sentences with a topic-marked NP in the sentence-initial position were analyzed.

(14) a. Taro-ga   Hanako-o   mitsuke-ta. $S_{NOM}OV$
Taro-NOM   Hanako-ACC   find-PAST
'Taro found Hanako.'

b. Hanako-o   Taro-ga   mitsuke-ta. $O_{ACC}SV$
Hanako-ACC   Taro-NOM   find-PAST
'same meaning as (14a)'

c. Taro-wa   Hanako-o   mitsuke-ta. $S_{TOPIC}OV$
Taro-TOP   Hanako-ACC   find-PAST

'As for Taro, he found Hanako.'

d.   Hanako-wa   Taro-ga   mitsuke-ta. $O_{TOPIC}SV$

        Hanako-TOP   Taro-NOM   find-PAST

        'As for Hanako, Taro found her.'

3.1.3. Procedure

Samples were accumulated from the novel corpus for each condition, and they were divided into discourse segments. Using regular expressions, samples containing *noda*-constructions, center embedded clauses, and double object constructions were removed. First, *noda*-constructions were excluded from the analysis because *da* is a copula and has at least one focused constituent (Hiraiwa and Ishihara 2001). Such informational properties will confuse what discourse context is appropriate for each condition, and make it more difficult to determine the interaction of word order and information structure. Hence samples containing *noda*-constructions were excluded. Second, center embedded clauses were avoided because they often cause a situation which cannot be dealt with under the current CT. Third, double object constructions are different from transitive constructions in that they have a dative argument. That is why I exempted this construction from the analysis. Lastly, spoken lines were treated separately from their environment because Kameyama (1998) claims that "Reported Speech is an embedded centering segment that is inaccessible to the superordinate centering level".

3.1.4. Data Analysis

For starters, a Fisher's exact test[6] was conducted to examine whether there were significant differences between each condition, and then it was applied within each condition.

3.2. Results

Table 1. Summary of observed frequency and expected frequency

T/WO and NPM	$S_{NOM}OV$	$O_{ACC}SV$	S_{TOPIC} OV	O_{TOPIC} SV	Total
Continue	143 (185)	2 (12)	1077 (1038)	36 (22)	1258
Retain	116 (107)	22 (7)	582 (599)	6 (13)	726
Shift	52 (64)	3 (4)	372 (357)	6 (8)	433
Zero	139 (95)	3 (6)	495 (531)	6 (11)	643
Total	450	30	2526	54	3060

Summary of the observed frequencies and expected frequencies are shown in Table 1, with the expected frequencies being enclosed in parentheses. Fisher's exact test revealed that there was a significant difference for the overall data ($\chi^2(9)=95.242$, $p<.001$). A series of Fisher's exact tests using the expected frequencies for each cell were conducted. Firstly, for the $S_{NOM}OV$ condition,

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[6] Fisher's exact test is a sort of χ^2-test and is used for analyzing data when one or more cells have a value smaller than 5.

Continue ($\chi^2(1)$=5.378, p<.05) and Zero($\chi^2(1)$=8.274, p<.01) resulted in a significant chi square, but Retain and Shift did not. In other words, the observed frequency for Continue was lower than its expected frequency, while the observed frequency for Zero was higher than its expected frequency. Secondly, for the $O_{ACC}SV$ condition the difference was significant both for Continue ($\chi^2(1)$=7.143, p<.05) and for Retain ($\chi^2(1)$=7.759, p<.01) but not significant for both Shift and Zero. Namely, the observed frequency of Continue was lower than its expected frequency, but higher for Retain under the $O_{ACC}SV$ condition. Thirdly, for the S_{TOPIC} OV condition, Fisher's exact test was not significant for all transitions. Fourthly, in the O_{TOPIC} SV condition, only Continue ($\chi^2(1)$=3.379, p<.10) was marginally significant, while the other transitions were not significant.

Table 2. Incorporate data based on topic marker

T/TOPM	without TOPM	With TOPM	Total
Continue	145 (197)	1113 (1061)	1258
Retain	138 (114)	588 (612)	726
Shift	55 (68)	378 (365)	433
Zero	142 (101)	501 (542)	643
Total	480	2580	3060

Next, each condition was divided into two groups based on whether it had the topic marker *wa* or not. Fisher's exact test demonstrated that there is a significant difference for the overall cells ($\chi^2(3)$=45.334, p<.001). Without the topic marker *wa*, Fisher's exact test was significant for Continue ($\chi^2(1)$=7.906, p<.01) and Zero ($\chi^2(1)$=6.918, p<.05) but not for Retain or Shift. To put it another way, the observed frequency was lower than the expected frequency for Continue, but higher for Zero. On the other hand, with the topic marker *wa* there was no significant difference for each transition.

3.3. Discussion

The main point I should note here is that I have empirically demonstrated using corpus data that a direct object is more often scrambled when it is Cb than when it is not Cb. This coincides with what is theoretically claimed by previous studies (Kuno 1987 and Ishi 2001) that a direct object is more often scrambled when it is topic, and, I as have shown, topic correlates with Cb. In other words, it is revealed that both $O_{ACC}SV$ and $O_{TOPIC}SV$ are preferred when direct objects are Cb because Retain frequently occurs when the direct object is Cb ($O_{ACC}SV$) and Continue often arises in $O_{TOPIC}SV$. In $O_{ACC}SV$, Retain can occur when entities other than direct object are Cb, i.e. adjuncts. Note that, for Retain in $O_{ACC}SV$, twenty out of twenty-two examples are cases where Cb is realized as a direct object and, even in the other two cases, Cb is realized as a possessor attached to the direct object. Hence, it can be said that direct object is Cb when it is scrambled. A typical example for Retain in $O_{ACC}SV$ is shown in (15), which is an example assembled from Japanese corpus data. In (15c), *soitsu* 'it' is once mentioned in (15b) and it is also the only referent which appears both in (15b) and in (15c), and hence it is Cb. Further, Cf ranking based on grammatical relations predicts that the subject *Aitsu* 'he' is Cp because the subject is higher than the direct object in the Cf ranking, but the Cp *Aitsu* 'he' is not equal

to the Cb *soitsu* 'it'. As a consequence, Retain is realized in (15c) because the Cb is the same as in (15b) but the Cp in (15c) is not Cb.

(15)   a.   pro   Saeki-no-mono-da,   ōsagishi-nona
            (It)   Saeki-GEN-thing-FOC   the great swindler-GEN
            Cb   [platinum]   Cf   [platinum, Saeki]
            'It belongs to the great swindler Saeki.'
       b.   Saisyo-ni   Ore-ga   pro   kari-tan-da
            at first   I-NOM   (it)   borrow-PAST-FOC
            Cb   [platinum]   Cf   [platinum, I]⁷
            'At first, I borrowed it.'
       c.   Soitsu-o   Aitsu-ga   totcha-ttan-da.
            It-ACC   he-NOM   steal-PAST-FOC
            Cb   [platinum]   Cf   [Saeki, platinum]
            'He stole it.'

(16) is an example for Continue in $O_{TOPIC}SV$. In (16b), *Sea Tiger* is Cb because it is the only referent which is realized in both (16a) and (16b). Moreover, *Sea Tiger* is Cp of (16b) because *Sea Tiger* is marked with the topic marker *wa* and thus it is topic, which is higher than subject in the Cf ranking, although it is also direct object. The crucial point here is that the direct object is Cb not only in $O_{ACC}SV$ but also in $O_{TOPIC}SV$. However, for SOV, there are many cases where the direct object is Cb but not scrambled. This means that a direct object being Cb is a necessary but not sufficient condition for scrambling as the Cb itself does not trigger scrambling.

(16)   a.   Shītaigagō-wa   daiikkai-no   tanken-ni
            Sea tiger.ship-TOP   the first-GEN   exploration-DAT
            syuppatsushi-ta.
            depart-PAST
            'As for Ship the Sea Tiger, it departed for the first exploration.'
            Cb   [Ø]   Cf   [Sea tiger, exploration]
       b.   Mochiron   sore-wa   hakusyaku-danchō-ga   hikiitei-ta
            of course   it-TOP   lord-admiral-NOM   head-PAST
            Cb   [Sea Tiger]   Cf   [Sea Tiger, lord admiral]
            'Of course, as for it, the lord admiral led it.'

The other results of the Centering Analysis are as follows. First, $S_{NOM}OV$ is frequently used when the whole sentence consists of new information in a local meaning: Zero is selected as a transition. Namely, the speaker selects $S_{NOM}OV$ when he or she would like to start a new discourse segment. In (17b), for instance, there is no referent which is mentioned in (17a) and thus Zero is realized, meaning that all referents in (17b) are new information in a local meaning.

(17)   a.   pro   sukoburu humandeat-ta.
            (He)   extremely   dissatisfied

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⁷ Although zero object is lower than subject in the grammatical relation hierarchy, it sometimes becomes Cp when no CONTINUE transition is otherwise available. Walker et. al (1994) proposed this rule which is called Zero Topic Assignment (ZTA).

Cb   [Plato]
                Cf   [Plato]
                'He was extremely dissatisfied.'
        b.   Tyōkan-ga   enzetsu-o   shi-ta.
                chief-NOM   speech-ACC   do-PAST
                Cb   [Ø]
                Cf   [administer, speech]
                'A chief gave a speech.'

Second, as mentioned above, $O_{ACC}SV$ is frequently chosen when the transition Retain occurs. In other words, $O_{ACC}SV$ is used when the speaker has been talking about a referent in the object position but intends to make a shift onto a new referent in the subject position: The object is the topic and the subject is the starting point of the next sentence. The question can be asked whether there are different types of topic that occur under Retain, i.e. shifted topic and continued topic. However, this split did not show a noticeable difference between the different topics, so other factors may be at work here.

        Using Retain more often than Continue violates the Ordering Rule stated in (18), which is revised from (11).

(18)   Ordering Rule
        Continue is preferred to Retain, which is preferred to Shift.

Thus, selecting $O_{ACC}SV$ is marked but almost exclusively used with Retain; the purpose of choosing $O_{ACC}SV$ is indicating information structure associated with Retain. See (15) as an example. Thirdly, under $S_{TOPIC}OV$, there was no significant difference between expected and observed frequencies, and so the Ordering Rule applies. Fourthly, as mentioned above, $O_{TOPIC}SV$ is preferred when the speaker has been talking about a referent in the object position and intends to continue focusing on it: Here Continue is often realized. See (16) for example, too. Fifthly, Continue correlates with the topic marker *wa*. In other words, Continue more frequently occurs when sentences contain the topic marker *wa*. Combined with the results of the $S_{NOM}OV$ and $O_{ACC}SV$ conditions, this effect can be interpreted as a property of the nominative case marker *ga* which often marks new information. Thus a nominative subject is frequently realized as an entity other than the Cb of the preceding utterance because Cb often corresponds to Topic which in turn usually coincides with given information, which is in complementary distribution with new information.

        In sum, an appropriate discourse context for word order variations in Japanese has been demonstrated, even though it is restricted to topical aspects. To put it more concretely, the correlation between scrambled word order and topicality was uncovered by CT. However, topicality is a general concept and is related to various grammatical operations, in Japanese, especially to zero pronoun and passive. Thus, topicality itself cannot completely explain the character of scrambling in discourse contexts. Furthermore, although such constructions are all concerned with topicality, there should be differences with regard to their appropriate discourse contexts because it would not be economical to have two constructions perfectly matching in function. Therefore, in order to explain the differences among them, other factors, for example shifted topic and continued topic (Ishii 2001), are needed.

        The results of the analysis based on Cf rankings which arise from grammatical relations reveal the function of word order permutations, but Strube and Udo (1999) claim that word order itself may affect the Cf ranking. Their proposal is that the degree of givenness and left-to-right order determines Cf ranking. In addition, Gordon, Grosz, and Gilliom (1993) empirically revealed that

surface position influences the Cf ranking. However, Milsakaki (2002) and Hoffman (1998) showed that grammatical relations are the most reliable determinant of Cf ranking. In fact, he revealed that grammatical relations have the greatest effect on Cfs even in scrambled word order in Turkish. Therefore, it is necessary to examine whether word order influences the Cf ranking to confirm the analysis offered above. One way to confirm this is to conduct a task which requires participants to write a continuation to a particular sentence. If grammatical relations are the only criteria or much stronger than word order itself for determining the Cf ranking, the entities referred to should be predicted by the results of this paper. To put it more concretely, if the given sentence is $S_{NOM}OV$, $S_{TOP}OV$, or $O_{ACC}SV$, participants should select the entity which is subject in order to depict the events in the writing task. On the other hand, if word orders have greater effect than grammatical relations on the Cf ranking, the participants are predicted to use entities which are inconsistent with the analysis offered above. In other words, for $O_{ACC}SV$ cases, participants may continue centering an entity which is the scrambled object. For example, if the analysis given above is correct, (19c) is preferable to (19d) as a continuation of (19b) because the Cf ranking based on grammatical relations expects the subject in (19b), *Taro,* to be Cb in the following utterance. On the other hand, if the analysis offered is wrong, participants may use (19d) as a continuation of (19b). This is because the object is scrambled in (19b) and the Cf ranking would be affected by this fronting. As a result, the Cf ranking of the object would be higher than the Cf ranking of the subject in $O_{ACC}SV$.

(19) a. Tsukue-no-ue-ni   ringo-ga   at-ta.
          desk-GEN-above-DAT   apple-NOM   exist-PAST
          'There were apples on the desk.'
      b. Ringo-o   Taro-ga   tabe-ta.
          apple-ACC   Taro-NOM   eat-PAST
          'Taro ate the apples.'
      c. Taro-wa   harapeko-dat-ta-no-da.
          Taro-TOP   very.hungry-be-C-COP
          'As for Taro, he was VERY HUNGRY.'
      d. Ringo-wa   Kōgyoku-dat-ta.
          apple-TOP   Kōgyoku-C-PAST
          'As for the apples, they were Kōgyoku. '

Further studies are needed to disentangle the issue whether the Cf ranking in a free-word-order language like Japanese is influenced by word orders or not. In other words, Cf ranking can be based mainly on grammatical relations, on surface positions, or on both factors. Moreover, it is also necessary to analyze various constructions using CT to investigate the suitable discourse context for scrambling. This comparison may shed more light on the true nature of scrambling.

4. Conclusion

In this paper, I have attempted to elucidate word order variations from the viewpoint of CT because motivations for changing word order in Japanese are not clear. The results of a CT analysis empirically demonstrated that scrambling an accusative object into sentence initial position is preferred when the direct object is Cb regardless whether the direct object is marked with accusative case *o* or topic marker *wa*. In other words, an object is often scrambled if it has been mentioned in a preceding sentence. Furthermore, these results suggest that an appropriate transition for $O_{ACC}SV$ is

Retain and the one for O_{TOP}SV is Continue. However, my analysis is exclusively based on grammatical relations, and hence further studies are required to test the analysis' validity.

Acknowledgement

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中心化理論による日本語の語順の分析
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キーワード：かき混ぜ文、中心化理論、談話機能、語順、トピック

日本語要旨

どのような談話文脈でかき混ぜ文が使われるのかということは明らかでない。そこで、中心化理論を用いて短距離かき混ぜ文(OSV)の分析を行った。その結果、かき混ぜられた目的語は談話トピックだという結果を示した。同時に、「OをSがV」では先行文の話題をOで受けて後続する文ではSの対象へと話題をシフトするのに対し、「OはSがV」ではOで受けた話題を後続する文でも維持する傾向があるということを示唆する結果を示した。

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